



# Reconstructing DNA with Borland Genetics

Tanner Blair Tolman, AG®  
9 November 2022

## Reconstructing is NOT...

- Is not used for cloning
- Is not used for resurrecting
- Does not do anything with physical DNA molecules at all

## Reconstructing DNA is...

- Is creating a word or text file that shows what genes (SNP's) a deceased person had at key locations in their DNA
- You are creating a DNA raw data file for an ancestor to resemble what a company would have made for them had they tested in life
- The ancestor's artificial raw data file can be put into sites that accept uploads just like a living person can upload their DNA

## Why Reconstruction is Useful

- A parent only passes down half of their DNA to a child
- Your ancestors share more DNA with your genetic relatives than you do.
- Autosomal DNA becomes harder and harder to use the more generations the test taker is removed from the research problem

## Warning

- It is much easier and cheaper to test someone's DNA while they are alive than it is to reconstruct it after they have died
- Test everyone in the oldest living generation that you can

## Limitations

- Start by reconstructing the DNA of those one generation above the living, then you could go back farther one generation at a time
- You will not be reconstructing Charlemagne or Cleopatra
- The ancestor typically needs to have at least 7 children to be able to reconstruct all of their DNA
- You can make a great reconstruction with 4 children

## DNA Raw Data

- The four possible gene's at each spot are A, C, G, and T
- The chromosome tells you which of the 23 chromosomes the gene is on
- The first gene on the left most side is at position 1, the next is at position 2, the next at 3 etc.
- Many genes are not tested because they are the same in all humans
- Neither Ancestry DNA nor 23andme tested the first 734461 genes on chr. 1
- At each spot I have one gene from my dad and one from my mom
- The way to know which is which is to compare against other relatives
- Only one of your alleles needs to match one of theirs at the same spot for it to be a matching SNP (half match)
- The odds that you will match a person at any one SNP is very high, it is only by matching them hundreds or thousands of times in a row that you know you have a true match

Click here for more information about SNP's and raw data

[https://www.familysearch.org/en/wiki/Single-Nucleotide\\_Polymorphisms\\_\(SNPs\)](https://www.familysearch.org/en/wiki/Single-Nucleotide_Polymorphisms_(SNPs))

## Strategy

- Every reconstruction is going to follow this basic pattern
- Figure out which genes were inherited from the target ancestor by comparing against another relative
- Put those genes into the reconstruction
- What relatives you have available to compare against will determine which tools you use

# The Borland Genetics Website

([www.borlandgenetics.com](http://www.borlandgenetics.com))

## Terminology

There are three terms that need to be explained in order for this page to make sense: Factory kit, Mono kit, and Stereo kit.

**Factory Kit:** A factory kit is a kit purchased from a company such as Ancestry DNA or 23andme. It contains two genes at each location tested, one gene from each parent.

- **Mono Kit:** A mono kit contains only one gene at each location. If done correctly, this one gene comes from the target ancestor. Mono kits are created by Borland Genetics by comparing two or more kits and then extracting out the desired genes. A mono kit can be up to but no more than a 50% reconstruction or a person's DNA.
- **Stereo Kit:** A stereo kit contains two genes at each location. All factory kits are stereo kits but the kits you create on Borland Genetics will be stereo kits but not factory kits. For best results you want to create a mono kit that only contains the target ancestor's paternal DNA and another mono kit that only contains the target ancestor's maternal DNA and then merge those together to create a stereo kit.
- **Evil Twin:** Each of your parents gave you half of their DNA. Your evil twin is a term to refer to all the DNA that you did not inherit from your parents. If your evil twin was alive they would also share half of their DNA with each of your parents, but they would share no DNA with you.
- **Child and Parent:** Child and parent refer to parent child relations not a person's age. A child can be 97.

## The Creeper

The flagship of Borland Genetics is "The Creeper." The Creeper is a smart tool that automatically determines the right tools to use for your project and greatly helps with the reconstruction process. The creeper can even perform visual phasing for you.

## Main Tools

**Two-Parent Phase:** This free tool creates high resolution phased output kits when DNA of both parents of a child donor is available. The child's DNA is compared to the DNA of both parents and thus the child's paternal and maternal DNA is separated from each other resulting in two mono kits for each parent. Each mono kit contains the DNA that the parent passed down to that child.

**Missing Parent:** This free tool creates a partial reconstruction of an unavailable parent when the DNA of the opposite parent of the child donor is available. It compares the DNA of the

parent and child, deletes out the genes that are present in both and only leaves the genes that are unique to the child because these genes must have come from the missing parent. This tool usually creates a mono kit with 50% coverage of the missing parent's DNA, but creates a 47% reconstruction if both the child and the missing parent are males because men do not inherit an X chromosome from their father. This tool is fairly simple and takes about 15 minutes to run.

**Reverse Phase:** This tool allows users to phase their DNA using the DNA of a child rather than a parent. It is an important tool for reconstruction because it allows the oldest living generation to separate out their paternal and maternal DNA without having one of their parents alive to test. However, this tool is more difficult to use than missing parent. First user's will need to compare the parent and child and create two mono kits. One mono kit is called the A and B kit. It contains all the DNA that the parent passed on two the child. The other is the A x B kit. It contains all the DNA that the parent did not pass on two the child and is the child's evil twin. Next, user's will need to create a map in DNA painter showing which portions of the parent's paternal and maternal DNA were passed down to the child. In other words you will need to make a map showing exactly which segments the child inherited from his or her two grandparents on the target side. Finally, the two mono kits are compared against the DNA painter map and the relevant segments are extracted from each one. The end result is two mono kits one that only has the parent's paternal DNA and one that only has the parent's maternal DNA.

Because this process is complicated and requires the user to be an expert in chromosome mapping and DNA painter. Borland Genetics offers both a free and a subscription version of this tool. In the free version, the user must do everything themselves, but the subscription version helps the user with all the steps and is much easier to use.

**Phoenix:** This free tool partially reconstructs a parent of a selected child donor by extracting shared DNA from family members on the same side of the family as the target parent. This tool is simply and easy to use. It finds all of a child's DNA matches in the database and then allows the user to select up to five relatives. The tool then compares the child's DNA against those relatives one at a time and anywhere their DNA matches, the matching segments are extracted out and put into a mono kit for the target parent. If you have more than five relatives, this tool can be run multiple times and then the results all merged together later.

**Darkside:** This free tool partially reconstructs a parent of a selected child donor by isolating DNA from the opposite copy of the child's chromosomes across regions where the child shares DNA segments with family members on the opposite side of the family as the target parent. It is essentially the opposite of the Phoenix. The child's DNA can be compared to up to five relatives and then in all the places where their DNA matches, the DNA in those same spots that is unique to the child are extracted to form a mono kit for the target parent. If you have more than five relatives, this tool can be run multiple times and then the results all merge together later.

**Humpty Dumpty:** Arguably the most important tool on the website. As you use each of the successive tools, you will end up with multiple mono kit that each have up to 50% of the target ancestor's DNA. To make a better reconstruction that has 50-100% of the target person's DNA, you will need to merge these drafts together using the Humpty Dumpty tool. (Can be accessed by clicking the "View/Edit Donor Profile" button on any of the eligible donors in your DNA Inventory.

Humpty Dumpty offers three options:

**Humpty Dumpty Option 1: Merge Mono to Mono:** This option is used to merge contributing mono DNA resources within a single child clade of the donor into a composite mono kit. From the resulting mono output kit, segments can be extracted that correspond to distinct ancestors of the donor, and therefore the output can be used as a building block for further DNA reconstruction. However, select this option only if the mono input kits were created by extracting only data from descendants of a single child of the donor.

**Humpty Dumpty Option 2: Mono to Stereo:** This option is used to merge contributing mono DNA resources across multiple child clades of the donor into a composite stereo kit. The resulting stereo output kit cannot be used to reconstruct individual ancestors of the donor, but may make a nice kit to generate matches on third party sites, as it will generally represent the most complete version of a reconstructed donor's genome that can be assembled using your available data. However, only select this option if the mono input kits were created by extracting data that spans multiple child clades with respect to the donor. For example, this is a great tool for merging data from multiple runs of the Missing Parent tool with the same available parent but multiple children. You will typically get the best results by first combining all data within clades using Option 1, and then merging the mono output kits corresponding to each clade using Option 2.

**Humpty Dumpty Option 3: Merge Factory Kits on Different Templates:** This option is used to merge multiple factory kits pertaining to the same living donor to create a single output kit capturing data recorded at all SNPs represented in the individual input kits. For example, if you tested at both Ancestry and 23&Me, this will combine the data and create a more detailed profile of your genome that will contribute to higher resolution reconstructions of your ancestors.

Other Tools

**Ultimate Phaser:** This free tool lets you compare two kits and then with the segments that match, assign the matching portions to an ancestor. You can instead choose to take the matching segments and take the DNA unique to one of individuals in that same spot (the dark side) and assign that DNA instead. (Can be accessed from the Chromosome Browser screen, by clicking the "Chromosome Browser" button on any of the matches to any of the kits in your DNA Inventory.)

**Extract Segments:** This lets you move segments from any mono kit to another individual's mono kit. (Can be accessed from the Kit Attributes screen, by clicking the "Explore in Kit Laboratory" button on any of the mono kits in your DNA Inventory.)

**Create a Private Project:** This subscription tool allows users to organize their DNA kits into projects. Users can also invite other users who have matching kits to submit them to their projects and collaborate. There are also three types of special Smart Projects (Reverse Phase, Visual Phasing and Creeper), in which the Creeper (the site's automated assistant) guides users through complex reconstruction workflows. Visual phasing and generic Creeper Smart Projects are currently under construction, but the unfinished versions are already available to subscribers for beta testing. The Creeper-assisted Reverse Phase Smart Project workflow is already completed.

**Global Surname Search (Beta):** This free tool allows users to search the database for profiles with a given surname.

**Chromosome Browser:** Can be accessed by clicking the "Chromosome Browser" button on any of the matches to any of the kits in your DNA Inventory.

**Regional Project Pilot Program Membership:** Qualifying kits can be submitted from the Kit Attributes screen

**Family Project Pilot Program Membership:** Qualifying kits can be submitted from the Kit Attributes screen

**Build 36 to Build 37 Conversion Tool:** This free tool allows users to paste a list of Build 36 segments from Excel and have them converted to Build 37 coordinates. This tool used to be more important when FamilyTreeDNA was using build 36 and all the other companies were using build 37. However, all the companies are now on build 37 even though build 38 is actually the newest build.

HIR Mapper V2.0 Can be accessed from the Kit Attributes screen, by clicking the "Explore in Kit Laboratory" button on any of the mono kits in your DNA Inventory.

**Phase Map Locker:** This subscription tool allows users to store chromosome maps in the Borland Genetics database where they can be integrated into a variety of tools and workflows. Typically you will create your chromosome maps in DNA Painter.

**Create a Private Project:** Creating a private project is how you activate The Creeper.

**Advanced Raw DNA data export options:** Subscribers have access to advanced download options that solve compatibility issues with sites that accept uploads. Subscribers can create custom headers, decide how the X chromosome is represented, insert white noise to simulate stereo output, choose between 4 and 5 column format, choose between tab and comma delimiters, apply file compression, and select other options. The ability to insert white noise is the most important part of this tool. Generally, if the reconstruction you make has less than about 80% of the person's DNA, you will need to insert white noise into the kit to make GEDmatch accept it.

## **Tools that are coming soon:**

### **Ultimate Ethnicity Tool**

**High-speed unlimited Phoenix and Darkside tools:** Currently the Phoenix and Darkside tools can only be used on five kits at a time or the server will overload. These tools will solve that problem and will be available for subscribers.

Click here for more information about Borland Genetics  
[https://www.familysearch.org/en/wiki/Borland\\_Genetics\\_in\\_Genealogy\\_Research](https://www.familysearch.org/en/wiki/Borland_Genetics_in_Genealogy_Research)

or just go to [www.borlandgenetics.com](http://www.borlandgenetics.com) and try it out yourself